

SPECIFICATION NUMBER: PS01, Rev 2

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**Purchase Specification
For The
625KW Ship Service Fuel Cell Demonstrator Test Site
Switchgear**

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1.0 Introduction

This purchase specification and all documents referenced herein contain all of the detailed requirements for (1) 480V, 2000A Switchgear Unit consisting of two metal enclosed vertical sections with a total of (6) drawout circuit breaker elements. The switchgear shall be Siemens Type R Switchgear with RLE-2000 and RLI-800 drawout circuit breaker elements, and static trip units type III or equal. The Switchgear Unit will be installed indoors at the Land Based Test Site in Bldg 77H at the Naval Surface Warfare Center, Carderock Division (NSWCCD), Philadelphia, Pa. The switchgear unit will be supplied 450 – 480VAC, 3 phase, 3 wire, 60 Hz, power from various power sources as described in this specification. The Switchgear will be used for Testing of a 625KW Ship Service Fuel Cell Demonstrator.

2.0 Scope

2.1 Equipment and Services to be Provided by the Supplier:

The Switchgear shall be suitable for industrial installation and shall be constructed in accordance with the best commercial practices. It shall be the Supplier's responsibility to furnish equipment suitable and complete in details for the services intended. The equipment shall be designed, constructed and tested in accordance with applicable regulations of IEEE, ANSI, NEMA, and the National Electrical Code, as specified herein. The Supplier shall be responsible for delivery of each of the following to NSWCCD-SSES in Philadelphia.

Item	Qty	Description
1	1	480V, 2000A Bus Switchgear, 60Hz, Nema 1 Enclosure
2	3	Switchgear Detail Drawing(s)
3	3	Technical Manuals
4	3	Spare Parts & Special Tools List
5	1	Test Data Sheet

2.2 Equipment and Services to be Provided by the Buyer:

The Buyer shall install the Switchgear. Also, the Buyer shall be responsible for the following items:

1. Mounting foundations, structural components and mounting bolts attaching the Supplier-furnished equipment to the site structure, and,
2. Associated cabling.

3.0 Applicable Documents

- NFPA-70, National Electrical Code
- IEEE C37.20.1 - Metal Enclosed Low Voltage Power Circuit Breaker Switchgear.
- ANSI C37.50 - Test Procedure for Low Voltage AC Power Circuit Breakers Used in Enclosures.
- ANSI C37.51 - Conformance Testing of Metal Enclosed Low Voltage AC Power Circuit Breaker Switchgear Assemblies.
- IEEE C37.13 - Low Voltage AC Power Circuit Breakers Used in Enclosures.
- ANSI C37.16 - Preferred Ratings, Related Requirements, and Application for Low Voltage Power Circuit Breakers and AC Power Circuit Protectors.
- NEMA C37.17 - Trip Devices for AC and General Purpose DC Low Voltage Power Circuit Breakers.

4.0 Release for Manufacture

The Supplier shall submit the following documents to the Buyer, for approval, prior to obtaining a Release for Manufacture:

Switchgear Detail Drawing(s) showing mounting details, equipment weight, cable entry, connection capabilities (number and size of cables), electrical schematics, electrical interconnections, and ratings of bus, breakers, and trip units.

5.0 Technical Requirements

Electrical Ratings:	480VAC (Max Voltage 508VAC), 60Hz, 3 phase, 3 wire, 2000A continuous minimum in 40C ambient. Breakers shall be rated for 85,000A RMS symmetrical short circuit interrupting rating with electrical system X/R<6.6. The breakers shall be able to interrupt maximum fault levels within .07 seconds of fault initiation. The breaker asymmetrical short circuit interrupting rating shall be a minimum of 100,000A RMS. Compatible bus short circuit ratings shall be provided for the breaker interrupting ratings specified. This switchgear will be supplied from various 60Hz electrical sources which are expected to be operated between 450VAC and 480VAC. These electrical sources have ungrounded electrical windings.
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Installation Location/ Enclosure/Type:	Indoors, NEMA 1 self supporting enclosure with top lifting provisions is required. Switchgear design shall allow bolting to (2) front and rear mounting channels which will then be bolted to a concrete deck. The enclosure shall be constructed of 14 gauge or thicker sheet steel with steel framing and an ANSI 61 light gray outdoor exterior finish. Each of the (2) vertical sections shall be no larger than 30"W X72"D X103"H. The rear section of the switchgear shall provide a minimum depth of 30" for cable entry and space for future Buyer installed current transformers. All breaker compartments (6 total qty) and control power transformer(CPT)/ relay compartments (2 total qty) in front of switchgear shall be isolated from each other and from the rear bus section. Each circuit breaker and CPT/ relay compartment shall be provided with a hinged front steel door secured with rotary latches requiring no tools to operate. Switchgear compartment designations and locations are shown in Figure 9.1 & 9.2.
Cable Terminations and Cable Entry:	Adequate space shall be provided to allow power cable passage and connection using Switchgear Supplied Nema two hole compression lugs with 1/2" diameter hardware. Swgr termination bolt holes for cable lugs shall accommodate lugs in the vertical or angled configuration to decrease stress on customer cabling. Cable Termination areas shall be rated for cable use at up to 90C ampacity. All power cables are expected to enter from the top rear of the switchgear and be connected to the appropriate breaker. See Figure 9.1 and 9.2 for expected layout and cabling.

<p>Breakers:</p>	<p>All breakers shall be (3) pole, single throw, stored energy mechanism Siemens type RLE – 2000, and RLI-800 or equal as indicated in Figure 9.2. Each breaker shall be electrically operated drawout type, padlockable in the trip position, interlocked to prevent racking out a closed breaker or racking in a closed breaker, interlocked to prevent closing breaker until fully racked to connected position or in test position, and interlocked to prevent racking a breaker into compartment with springs charged. Local breaker opening, closing, and manual spring charging shall be available without opening the compartment door. Breaker status indicators (open, close, springs charged, connected, test, and disconnected position) shall be visible without opening the compartment door. It shall also be possible to rack the breakers from the disconnect to connected position with the breaker compartment door closed. The breakers shall be equipped with a current sensor in each phase as shown in Figure 9.2. The current sensors supply the static trip units. A breaker racking tool shall be included with the switchgear. Maintenance space required in front of breaker cubicle door shall not exceed 46 inches. Each breaker shall have a N/O & N/C contact available for remote breaker mechanism position indication. These contacts should be wired out to a switchgear terminal block for customer connection.</p> <p>Each breaker shall have a separately fused 120vac control circuit with 120vac spring charging motor which will automatically keep the breaker ready to operate locally as well as provide capability of remote operation via an open and close interposing relay both of which would have a 120vac coil. One interposing relay shall have its N/O contact wired into the breaker open control circuit and its coil wired to a switchgear terminal block for remote control connection by customer. One interposing relay shall have its N/O contact wired into the breaker close control circuit and its coil wired to a switchgear terminal block for remote control connection by customer.</p> <p>The source of the switchgear breakers control power shall be from each of the switchgear 480-120vac control power transformers (see Figures 9.2 & 9.3). The control power transformer being utilized is selected by the voltage sensitive relays which are also located in the switchgear and shown in Figure 9.3.</p> <p>(See next page for continuation)</p>
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	<p>The following electrically operated breaker interlocks shall be provided to insure breakers specified are not closed into an out of phase power system condition:</p> <p>LBES Bkr 2D – Shall not be permitted to close if the Facility Power Bkr 1C is already closed or if there is voltage already present on the Swgr Main Bus.</p> <p>Facility Power Bkr 1C - Shall not be permitted to close if LBES Bkr 2D is already closed or if there is voltage already present on the Swgr Main Bus.</p> <p>Fuel Cell Enclosure Bkr 1D - Shall not be permitted to close if there is already voltage present on the Swgr Main Bus.</p> <p>Note: The electrically operated breaker interlock consists of an additional solenoid added to the breaker which must be energized before the breaker can be closed. When the interlock is deenergized the breaker is held trip free and can not be closed electrically or manually. The interlock has a manual link that goes to the main shaft of the breaker. The interlock is held in the picked up position when the breaker is closed. Once the breaker is closed, the interlock can be deenergized without tripping the breaker.</p>
Breaker Trip Units:	<p>The breakers shall have self powered RMS sensing overcurrent protection (Siemens Static Trip III or equal) with long time, short time, and instantaneous elements</p> <p>The breaker trip units shall allow various Long Time (.5, .55, .6, .65, .7, .75, .8, .85, .9, .95, 1.0 X Sensor Amp Rating), Short Time (2, 3, 4, 5, 6, 8, 12 X LT Setting), and Instantaneous (2, 4, 6, 8, 12, 15 X Sensor Amp Rating) current setpoints. Various delay curves shall also be available for LT and ST.</p>
Bus Bars:	<p>Bus Bars shall be tin plated copper and shall include a ground bus bar. The Breaker primary & secondary disconnects shall be silver plated.</p>
Fuses:	<p>(3) – 100A, 600V current limiting class RK5 fuses with fuse block shall be provided with cabling connection to the switchgear bus as shown in Figure 9.2 for future Buyer connection to PP2. Fuses shall be Bussmann Cat# FRS-R-100 or equal.</p> <p>(2) – current limiting primary fuses and one secondary fuse with fuse blocks shall be provided for each switchgear control power transformer (CPT). See Figures 9.2 and 9.3 for more details.</p>

Control Wiring:	Control wiring shall be type SIS, flexible stranded copper conductor, with 600V or 1000V, 90°C insulation. Minimum wire size is 14AWG. Wires shall be marked at each end with sleeve type wire markers. Wire markers shall be machine imprinted with the wire name as indicated on the wiring diagrams. Wire terminations shall utilize insulated ring tongue lugs except where connecting to components which do not accept these terminations.
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6.0 Technical Data

6.1 Drawings

Three sets of Switchgear Detail Drawing(s) showing mounting details, equipment weight with center of gravity, cable entry, connection capabilities (number and size of cables), electrical schematics, electrical interconnections, and ratings of bus, breakers, and trip units. The Buyer will approve the Suppliers drawings and provide a release for manufacture.

6.2 Technical Manuals

Three sets of Technical Manuals shall be forwarded not later than the delivery date of the equipment. Technical manuals may consist of manufacturer catalog data and technical data sheets for the equipment provided. Installation, Post Installation Testing , Operating Instructions, and Maintenance shall be included in the Technical Manual.

6.3 Spare Parts and Special Tools

A list of the recommended spare parts and special tools shall be provided with the proposal.

7.0 Inspection and Testing

Production Testing:	Production Testing on the switchgear shall be performed and shall include the following: dielectric, breaker overcurrent testing with utilization of primary current, functional checks of all breakers, auxiliaries, and related circuits which includes verification that all interlocks, padlocking, racking mechanisms, etc. are properly operating. Testing shall be documented and performed in accordance with industry standards prior to shipment. Test data sheets shall be provided to the buyer. The Customer reserves the right to witness Supplier Testing and to inspect the Switchgear prior to shipment to assure the supplied equipment meets the prescribed requirements.
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Design Tests:	Design tests such overload switching, endurance testing, short circuit, dielectric withstand voltage, trip device calibration, and heat run current testing, etc. are required to have been performed at some time in the past to prove the component types being utilized in this switchgear are acceptable. These tests shall have been documented and performed in accordance with industry standards prior to shipment. Test documents shall be made available upon buyers request.
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8.0 Shipping

8.1 Packaging

Equipment shall be packed for shipping in a manner which will ensure acceptance and safe delivery at destination. Supplier is responsible for damage during shipment.

8.2 Marking

Each Package shall be marked with the Contract Number, Contract Item Number, and Purchase Specification PS01.

8.3 Delivery

All equipment and technical data specified in this document shall be delivered to NSWCCD-SSES within 12 weeks after contract award to the address given below:

Commander
 Naval Surface warfare Center Carderock Division
 Naval Business Center Bldg 542
 Philadelphia, Pa. 19112-5083
 Attn: Mr. Ed House, Code 824

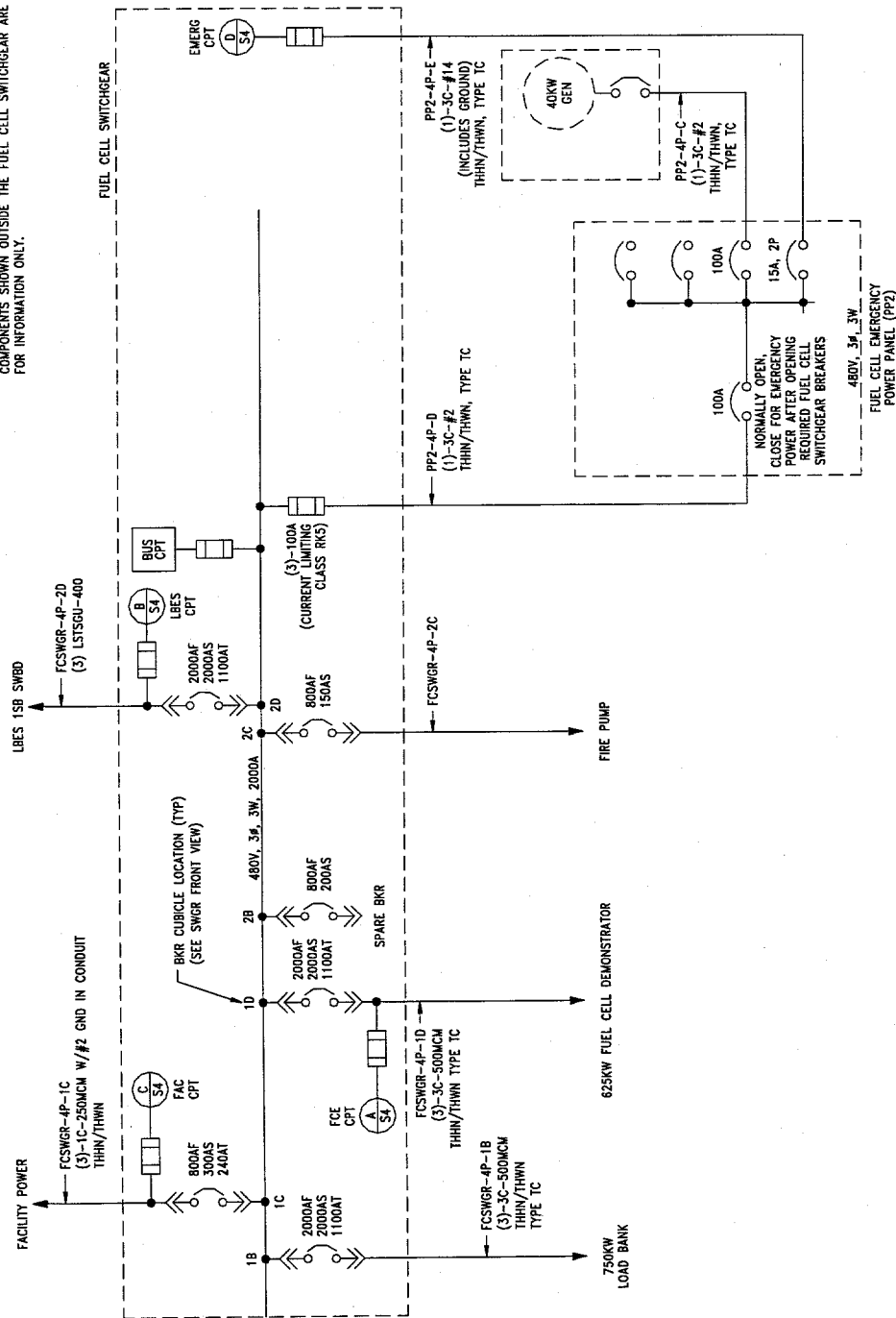
9.0 Figures

9.1 Switchgear Front View

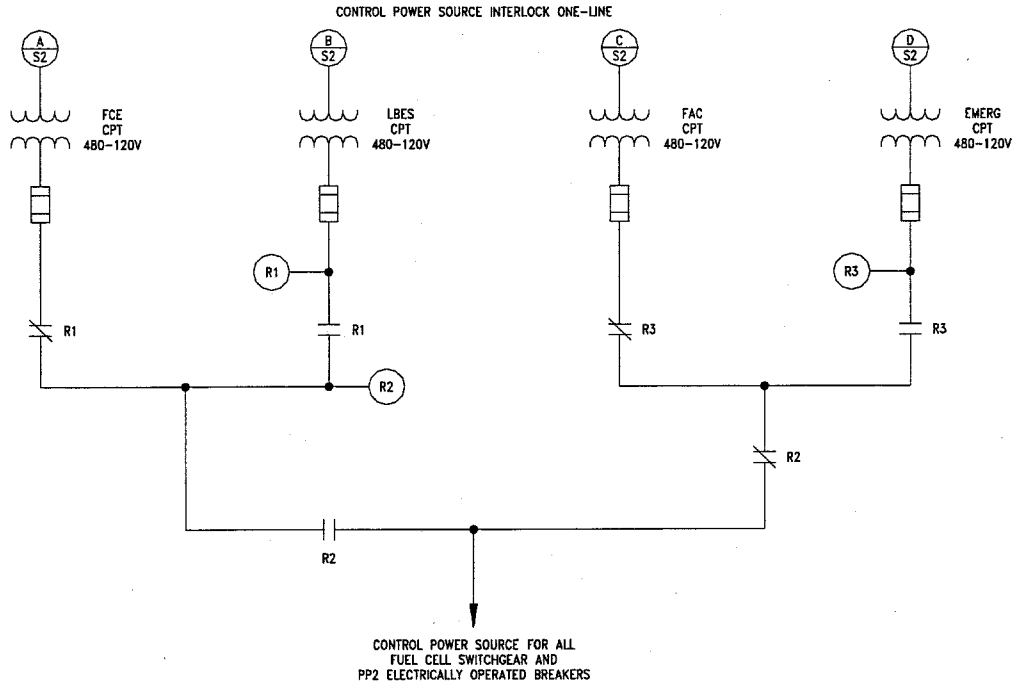
CPT / Relay Compartment 1A	CPT / Relay Compartment 2A
750KW Load Bank Bkr 1B	Spare Bkr 2B
Facility Power Bkr 1C	Fire Pump Bkr 2C
Fuel Cell Bkr 1D	LBES 1SB Swbd Bkr 2D

NOTES

1. AF = BREAKER AMP FRAME
AS = BREAKER AMP SENSOR
AT = BREAKER LONG TIME AMP TRIP
2. THE SUPPLIER IS ONLY TO PROVIDE THE FUEL CELL SWITCHGEAR. COMPONENTS SHOWN OUTSIDE THE FUEL CELL SWITCHGEAR ARE FOR INFORMATION ONLY.



9.3 Control Power Source Interlock One Line



NOTES

1. ALL RELAY CONTACTS ARE BREAK BEFORE MAKE.
2. SEE FUEL CELL SWITCHGEAR ONE LINE FOR LOCATION OF CONNECTION FOR ALL CPT'S.
3. CONTROL POWER TRANSFORMERS HAVE TWO PRIMARY SIDE FUSES SHOWN IN THE FUEL CELL SWITCHGEAR ONE LINE AND ONE FUSE ON THE SECONDARY SIDE.
4. CONTROL POWER TRANSFORMER SECONDARIES HAVE NON FUSED SIDE GROUNDED.
5. RELAY CONTACTS ARE SHOWN WITH RELAY IN ITS SHELF STATE (DE-ENERGIZED CONDITION).